

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: GEUN-YOUNG YEOM, ET AL.

FOR: LAYER-BY-LAYER ETCHING APPARATUS USING NEUTRAL BEAM AND
METHOD OF ETCHING USING THE SAME

PRELIMINARY AMENDMENT

The Assistant Commissioner of
Patents and Trademarks
Washington, DC 20231

Dear Sir:

Prior to the Examiner acting in the above-referenced application, please
preliminary amend the claims as follows:

IN THE CLAIMS:

Please replace claims 1-4, 7-11 and 14-15 with the following re-written clean version.

1. (Amended) A layer-by-layer etching apparatus using a neutral beam,
the layer-by-layer etching apparatus comprising:

a reaction chamber having a stage therein on which a substrate to be etched is
mounted;

a neutral beam generator for generating a neutral beam from a source gas to
supply the neutral beam into the reaction chamber;

a shutter disposed between the neutral beam generator and the reaction chamber,
for controlling the supply of the neutral beam into the reaction chamber;

an etching gas supply for supplying an etching gas into the reaction chamber;

a purge gas supply for supplying a purge gas into the reaction chamber; and

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a controller for controlling the supply of the source gas, the etching gas, and the purge gas and opening and closing of the shutter.

2. (Amended) The layer-by-layer etching apparatus of claim 1, wherein the neutral beam generator comprises:

an ion source for extracting an ion beam having a predetermined polarity from the source gas and accelerating the ion beam; and

a reflector positioned in a path of the ion beam accelerated from the ion source, for reflecting and neutralizing the ion beam.

3. (Amended) The layer-by-layer etching apparatus of claim 2, wherein the reflector has a plate shape.

4. (Amended) The layer-by-layer etching apparatus of claim 2, wherein the reflector comprises a plurality of co-centric cylindrical reflecting members and different polar voltages are applied to adjacent reflecting members.

7. (Amended) The layer-by-layer etching apparatus of claim 1, wherein the substrate to be etched contains silicon.

8. (Amended) A layer-by-layer etching method using a neutral beam, comprising:

(a) loading a substrate to be etched, on which a layer to be etched is exposed, on a stage in a reaction chamber;

(b) supplying an etching gas into the reaction chamber to adsorb the etching gas on a surface of an exposed portion of the layer to be etched; and

(c) irradiating a neutral beam on the layer to be etched on which the etching gas is adsorbed

9. (Amended) The layer-by-layer etching method of claim 8, wherein steps (b) and (c) form one cycle which is repeatedly performed to etch the layer to be etched from the surface of the layer in a layer-by-layer manner.

10. (Amended) The layer-by-layer etching method of claim 9, wherein a monoatomic layer distributed on the surface of the layer to be etched is etched by half whenever the cycle is performed one time.

11. (Amended) The layer-by-layer etching method of claim 8, wherein in step (c) acceleration energy of the neutral beam is controlled so that sputtering does not occur on the surface of the layer to be etched.

14. (Amended) The layer-by-layer etching method of claim 8, further comprising removing excessive etching gas remaining before the step (c).

15. (Amended) The layer-by-layer etching method of claim 8, wherein in step (c), the neutral beam is irradiated from an ion source for extracting an ion beam having a predetermined polarity from a source gas and accelerating the ion beam and a neutral beam generator having a reflector which is positioned in a path of the ion beam accelerated from the ion source and reflects and neutralizes the ion beam.

Please insert the following newly added claims 16-21.

16. (Newly Added) The layer-by-layer etching apparatus of claim 3, wherein the reflector is tiltable to control an angle of incidence of the ion beam which is incident thereto.

17. (Newly Added) The layer-by-layer etching apparatus of claim 1, wherein the neutral beam is an argon neutral beam.

18. (Newly Added) The layer-by-layer etching apparatus of claim 1, wherein the etching gas comprises a chlorine gas.

19. (Newly Added) The layer-by-layer etching method of claim 8, further comprising removing etch by-products generated by the irradiation of the neutral beam after the step (c).

20. (Newly Added) The layer-by-layer etching method of claim 14, wherein the removing excessive etching gas comprises supplying a nitrogen gas as a purge gas to the reaction chamber.

21. (Newly Added) The layer-by-layer etching method of claim 19, wherein the removing etch by-products comprises supplying a nitrogen gas as a purge gas to the reaction chamber.

REMARKS

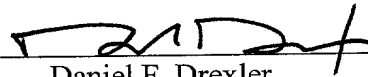
Applicants request entry of the above-identified amendments which conform the claims to U.S. practice. No new matter is being introduced by this Amendment as antecedent support is set forth in the specification and the original claims.

Prosecution on the merits is respectfully requested.

If there are any charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' attorneys.

Respectfully submitted,
GEUN-YOUNG YEOM, ET AL.

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Version with Markings to Show Changes Made

Claims 1-4, 7-11 and 14-15 are amended herein as follows.

1. (Amended/Marked up) A layer-by-layer etching apparatus using a neutral beam, the layer-by-layer etching apparatus comprising:

- a reaction chamber having a stage therein on which a substrate to be etched is mounted;
- a neutral beam generator for generating a neutral beam from a source gas to supply the neutral beam into the reaction chamber;
- a shutter [installed] disposed between the neutral beam generator and the reaction chamber, [the shutter] for controlling the supply of the neutral beam into the reaction chamber;
- an etching gas supply for supplying an etching gas into the reaction chamber;
- a purge gas supply for supplying a purge gas into the reaction chamber; and
- a controller for controlling the supply of the source gas, the etching gas, and the purge gas and [the] opening and closing of the shutter.

2. (Amended/Marked up) The layer-by-layer etching apparatus of claim 1, wherein the neutral beam generator comprises:

- an ion source for extracting an ion beam having a predetermined polarity from the source gas and accelerating the ion beam; and
- a reflector positioned in [the] a path of [an] the ion beam accelerated from the ion source, [the reflector] for reflecting and neutralizing the ion beam.

3. (Amended/Marked up) The layer-by-layer etching apparatus of claim 2, wherein the reflector [is formed of] has a plate shape [which may be tilted to control an angle of incidence of an incident ion beam to the horizontal surface of the plate].

4. (Amended/Marked up) The layer-by-layer etching apparatus of claim 2, wherein the reflector [is formed of] comprises a plurality of [overlapped] co-centric cylindrical [reflectors] reflecting members and different polar voltages are applied to adjacent [reflectors] reflecting members [of the overlapped cylindrical reflectors].

7. (Amended/Marked up) The layer-by-layer etching apparatus of claim 1, wherein the substrate to be etched [is a substrate containing] contains silicon[, the neutral beam is an argon neutral beam, and the etching gas is a chlorine gas].

8. (Amended/Marked up) A layer-by-layer etching method using a neutral beam, [the layer-by-layer etching method] comprising:

(a) loading a substrate to be etched, on which a layer to be etched is exposed, on a stage in a reaction chamber;

(b) supplying an etching gas into the reaction chamber to adsorb the etching gas on [the] a surface of an exposed portion of the layer to be etched; and

[(c) removing excessive etching gas remaining after being adsorbed;]

[(d)] (c) irradiating a neutral beam on the layer to be etched on which the etching gas is adsorbed[; and

(e) removing etch by-products generated by the irradiation of the neutral beam].

9. (Amended/Marked up) The layer-by-layer etching method of claim 8, wherein steps (b) [through] and [(e)] (c) form[s] one cycle which is repeatedly performed to etch the layer to be etched from the surface of the layer in a layer-by-layer manner.

10. (Amended/Marked up) The layer-by-layer etching method of claim 9, wherein a monoatomic layer distributed on the surface of the layer to be etched is etched by half whenever the cycle is performed one time.

11. (Amended/Marked up) The layer-by-layer etching method of claim 8, wherein in step [(d)] (c) acceleration energy of the neutral beam is controlled so that sputtering does not occur on the surface of the layer to be etched.

14. (Amended/Marked up) The layer-by-layer etching method of claim 8, [wherein steps (c) and (e) are performed using a nitrogen gas as a purge gas] further comprising removing excessive etching gas remaining before the step (c).

15. (Amended/Marked up) The layer-by-layer etching method of claim 8, wherein in step [(d)] (c), the neutral beam is irradiated from an ion source for extracting an ion beam having a predetermined polarity from a source gas and accelerating the ion beam and a neutral beam generator having a reflector which is positioned in a path of the ion beam accelerated from the ion source and reflects and neutralizes the ion beam.